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The More Important Fruit Tree Diseases of Ontario

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INTRODUCTION.

The object of this bulletin is to furnish all who are interested in fruit growing with information which will enable them to identify the more common diseases of fruit trees and to apply successfully the treatments which experiments and observations extending over a period of eighteen years have shown to be the most effective in each case.

WHAT FUNGUS DISEASES ARE.

The majority of the diseases of fruit trees are what are known as fungus diseases. It is important that those having to deal with them should understand fully the causes of such diseases, in order that they may apply intelligently, remedies for their control. Fungus diseases are caused by plants known as fungi. These plants, unlike ordinary flowering plants, have no green colouring matter (chlorophyll), and are unable therefore to manufacture their own food. All their nourishment must be obtained from decaying animal or vegetable remains or from living animals or plants. Those fungi which derive their nourishment from living plants in so doing injure them in various ways and thus give rise to what are known as fungus diseases.

The bodies of fungi which cause plant diseases are usually very simple, consisting of very fine, delicate, thread-like structures (hyphæ), some of which become modified and produce reproductive bodies called spores, which may be considered similar to the seeds of flowering plants. Sometimes the fungus threads live upon the surface of the plants and obtain their nourishment by sending down little suckers (haustoria) into the cells below. Most frequently, however, they live within the plants, either in or between the cells. Two kinds of spores are frequently produced—thin-walled summer spores, which spread the organism during the growing season, and thick-walled resting or winter spores, which serve to carry it over the winter. Spores are scattered by various agencies, chief among which are wind, water and insects. On coming in contact with a suitable host plant they send out little threads (germ-tubes), which enter the plant through the breathing pores on the leaves (stomata), through the skin or through wounds. Once within the plant the little

threads grow very rapidly, drawing their nourishment from the cells of the host plant and setting up a diseased condition.

Generally speaking, in combating fungus diseases, methods of prevention only are practicable. Once a fungus is within the plant nothing can be done to destroy it. Spraying with lime-sulphur, Bordeaux mixture or other fungicide is not done to cure but to prevent disease. In other words, the object of spraying is to cover the surface of the leaves, fruits or other parts of the plant with a substance poisonous to the spores of fungi, in which they cannot grow and penetrate the plant. Spraying, therefore, in order to be effective, must be timely and thorough. The spray mixture must be on the tree before the spores reach it and the surface of the leaves, fruit and other parts of the plant must be completely covered so that there is not the smallest space on which a spore can germinate.

SPRAY OUTFITS.

Those who purpose buying spray outfits and spray material can find the addresses of the various manufacturers by looking over the advertisements in the agricultural and horticultural journals.

If there are only a few trees to spray, such as one finds in a backyard in a town, a small hand pump, holding five to ten gallons of liquid, will suffice. This should be equipped with about twenty-five feet of good hose and an eight-foot bamboo pole with an angle-disc nozzle. Such an outfit costs from $20.00 to $30.00.

In small orchards of about three acres of moderately large apple trees, or of about six acres of plum or cherry trees, it is possible to do good spraying with a barrel pump of forty gallons capacity. This should be equipped with twenty-five or thirty feet of good hose and an eight-foot bamboo rod with two angle-disc nozzles on a V. This kind of outfit will cost from $35.00 to $60.00.

For all larger orchards hand outfits are too slow and therefore gasoline power machines should be used. There are many kinds of these, some adapted for small orchards and some for large. The cost varies with the power and size of the outfit and runs from about $300.00 up to about $900.00. All power outfits are equipped with either single or double guns according to the wish of the purchaser. Double guns are not satisfactory unless the machine will maintain constantly a pressure of 300 lbs. At this pressure they are preferable to single guns, because they cover the trees much more quickly and are less likely to burn the foliage. Single guns are well adapted to pressures of from 200 to 300 lbs., but not for any pressure less than 200 lbs. At high pressures they send so forcible a spray that unless carefully operated they are likely to cause serious burning.

In many cases, instead of buying two guns, it is wise to purchase one gun and a seven or eight-foot bamboo pole, equipped with two or even three angle-disc nozzles. The pole and nozzles give a much finer spray and cover a wider area at a time than a gun, especially a single gun. Hence a poor sprayer is likely to do a better job when spraying with the wind with a pole than with a gun. The pole and nozles are not so well adapted as the guns for spraying against the wind or even partly against it.

If the trees are thrifty and over fifteen years of age it is almost always wise to have a support on the top of the tank so that one man can spray from it and thus be able to use a finer spray and yet cover all the top of the tree with ease. The simplest and most convenient kind of support can be made easily, and consists of a 2 x 4 inch piece of timber about the length of the cover of the tank, and supported by two legs at or near

each end as on a sawhorse. Each pair of legs should be firmly mortised into a board and then the board screwed on the top of the tank. This makes it possible to remove the whole support when necessary. The operator stands straddle of this sawhorse support and so can move about freely without danger of falling. Moreover, this sort of support being directly over the centre of the tank enables it to pass between large trees without catching the branches.

Good care of any outfit is absolutely essential, otherwise it may last only a single season. If, however, it is kept well oiled and in good working condition, is washed out at the end of every application, or better still, at the end of every day's work, and, if, before putting it away for winter at the end of the spraying season, all water is drained off and all parts likely to corrode are well oiled, and oil pumped through the cylinders of the pumps, it should last for many years.

SOME SUGGESTIONS ON SPRAYING.

Most of our good growers are getting from 90% to 99% of absolutely clean fruit every year. This should be the aim of every fruitgrower, otherwise he will not secure the maximum benefit from the work he puts on spraying. But no one will secure such a percentage unless he does good, thoughtful work. The following suggestions will help him towards this goal.

(1) Every spring before the season opens see to it that the spray outfit is thoroughly overhauled and tested to make sure that it is working well and giving good pressure.

(2) Have all spray materials ordered up and on hand several weeks before the spraying operations begin so that there will not be an hour's delay when the time arrives.

(3) Have a convenient place for filling the tank rapidly. Ten minutes are long enough to fill even a 200-gallon tank. Have also scales, measures and materials arranged in a handy manner, so that there may be no waste of time in getting these into the tank.

(4) In an emergency, especially where rain is threatening, do not hesitate to work overtime, even though you have to pay your helper extra for doing so. An hour or two of spraying just before a wet spell may save you hundreds of dollars by keeping off scab from apples or rot from cherries or plums.

(5) Get a spray calendar and follow as closely as you can the instructions given there for each kind of fruit.

(6) Remember that the timing of the sprays is just as important as the thorough covering of the fruit and foliage. The times stated in the spray calendar are as nearly right as our knowledge can make them, and, if each application is given just at the time indicated, it will always or almost always protect the fruit until the next one is due; but if one spray is omitted or given at the wrong time and the weather in the meantime becomes wet, apple scab or brown rot or whatever disease is threatening may get a start and no later spraying will be able to atone for the mistake.

(7) In spraying aim at covering every part of the fruit or foliage thoroughly. On large trees this is not easily done and requires much care and systematic work. Do not forget that it is always the side of the fruit which is most shaded, that is the side which points towards the centre or trunk, which is most likely to be attacked by disease. Hence see that you spray everything from the side you are working on right through to the other side. Then when doing the opposite side of each row keep this same aim in view. Another important part of the tree likely to be poorly sprayed

is the top, so when doing this hold the spray a little longer on it than on the lower parts and see that it also shoots over the top and falls down on the other side. Standing on a tower or on the tank helps of course in the case of tall trees.

Sometimes after the orchard has been sprayed from one side the wind fails to change and yet threatening rain or the stage of the fruit makes it necessary to get the spray on the other side at once. In such cases it is often possible to get over the difficulty by starting earlier in the morning or spraying after supper when the wind has gone down. When this cannot be done the difficulty can usually be overcome fairly well by driving straight into the wind and shooting the spray in at right angles to it from one side. Then come back again and go up the other side of the trees against the wind and shoot the spray in at right angles from this side also. This means spraying the tree from three sides and using more material than would have been required had it been possible to spray both sides with the wind. Wherever the wind is at all against the operator a spray gun is much better than a rod and nozzles.

SPRAY CALENDARS.

Two spray calendars, one for apples and the other for pears and tender fruits, have been prepared by the entomologists and plant pathologists of the Province and Dominion acting in co-operation. These calendars are revised annually and thus are always kept up-to-date. They tell the time to make each application, the mixture to use, the right strength of each and the number of applications necessary. No grower can afford to do without these calendars. Be sure to get the new ones each year.

DUSTING VERSUS SPRAYING.

Applying spray materials by means of a power duster is a very rapid and handy method, but unfortunately most persons fail to obtain as good control by it as by spraying. Nevertheless where there is a large orchard,

Dusting fruit trees for insects and diseases. (Original.)

a duster is very convenient and enables the grower in an emergency to treat his whole orchard before it is too late. If only one outfit is to be used, we advise the sprayer as much the more reliable, especially as oil sprays are sometimes necessary and these of course can only be applied by a sprayer.

Apple Scab, (*Venturia inaequalis* (Cke) Wint).

This is the most common and most serious disease of apples in Ontario. It occurs wherever apples are grown and the scab spots on the fruit and leaves are familiar to almost every fruit grower. It is the chief disease that the grower has in mind when he is doing his spraying. In wet seasons scab causes a loss of many thousands of dollars to the fruit growers of the Province. This is to a large extent a needless loss, for apple scab can be prevented, no matter how wet the season may be, by timely, thorough and intelligent spraying. Such spraying, however, can be done only when the fruit grower understands the nature of the disease and how it is spread, and knows the climatic conditions which favour the spread and development of the fungus which causes it. Such knowledge is invaluable in the control of apple scab. It makes clear the necessity for timely and thorough spraying to insure protection of fruit and foliage from scab infection during the times in the spring and summer that it is most likely to occur.

Symptoms—Apple Scab affects the blossoms, fruit, leaves and rarely the twigs. It is most conspicuous on and does most damage to the fruit and leaves. Scab may appear on the fruit during any stage of its development provided climatic conditions are such as to render possible the spread and growth of the fungus which causes it. Young fruits on which scab spots develop are often stunted and deformed. Mature fruit is rendered unsightly and unsaleable by the conspicuous black and brown scab spots often bordered with a greyish rim. In severe scab there is sometimes a cracking of the fruit, such as is often seen when Pear Scab destroys Flemish Beauty pears. Not only does the scab render the fruit unsightly but it also makes it very liable to shrivel or rot in storage. If scabby apples are packed during moist, warm weather, or kept in a moist condition, a pinkish white mould is very likely to develop around the edges of the spots. This soon causes a rotting which markedly injures the fruit and makes it unpalatable. This is known as Pink Rot. Other rots caused by Blue Moulds (Penicillium) and other fungi, also develop around scab spots on apples in storage. Such fruit of course is hard to market and can be sold only at very much reduced prices. In some seasons apples when packed show little or no signs of scab but when they are examined two or three weeks later small scab spots are found to have developed on them. This is due to the fact that spores of the scab fungus were on the apples when they were packed and there was sufficient moisture in the barrels for these spores to germinate and infect the packed apples.

On the blossoms scab usually appears first on the tips of the sepals. Sometimes it affects the stems of the blossoms, causing them to drop, thus reducing very markedly the set of the fruit. Frequently the scab fungus infects the base of the calyx of the blossom, and, as this will become the fleshy part of the apple, such infections result in the young fruits being scabby and often deformed.

On the leaves the scab first appears as small, somewhat circular olive-brown spots which are seen first on the lower surface and later on both surfaces. Under weather conditions favourable to the fungus these increase in size, run into each other and become brown or black so that a considerable portion of the leaf is destroyed. In severe attacks the leaves become crinkled and to some extent curled. Sometimes they fall but most frequently they remain on the tree. The leaves are the food factories of the tree. The food manufactured by them is used for the growth of the fruit, stems and root, and for the formation of fruit buds next year. Hence severe injury to the leaves by scab impairs the vitality

of the tree and prevents the normal development of fruit buds, and thus may reduce the crop.

Varieties of apples differ very much in regard to their freedom from scab. It is a great help in controlling scab to know something regarding the susceptibility of the different varieties, as the scab is very much

Apple Scab on fruit. (Original.)

Apple Scab on leaves. (Original.)

harder to control on varieties which are very susceptible to it than on those which are not. Common varieties of apples which are (a) very subject to scab—Snow, McIntosh, Gravenstein, Early Harvest, Stark, Baxter, and St. Lawrence; (b) moderately subject to scab—Spy, Rhode

Island Greening, King, Baldwin and Ben Davis; (c) slightly subject to scab—Duchess, Blenheim, Yellow, Transparent, Tolman and Golden Russet.

Life History—The fungus which causes scab passes the winter chiefly in the fallen leaves beneath the trees. If these are examined in the early spring small black points will be seen projecting from the skin of the leaf on one or both sides. They vary in size from a mere speck to a pin head. Each is a fruiting body (perithecium) of the fungus and contains numerous long, sac-like structures (asci), (see illustration), each of which in turn contains eight two-celled spores (ascospores). When mature each fruiting body (perithecium) opens by means of a minute pore through which the spores are shot out from the sacs by a peculiar popgun-like arrangement. Moisture is necessary for the discharge of these spores, which takes place chiefly during the spring rains from the time the blossom buds are bursting until the petals are falling. Some of these spores

Section of Fruiting Body (Perithecium) of the Apple Scab fungus, showing the discharge of the spring spores (ascospores). (After Wallace.)

however, may be discharged much later in the season than this. These spores infect the unfolding leaves and blossoms, and give rise to the first scab spots of the season. Moisture is essential for the discharge of these spores and for their germination and development. When there is plenty of moisture these spores germinate and send out a tiny thread-like structure (germ tube) which penetrates beneath the outer layer of the skin (cuticle) of the leaf or blossom. It has been shown that the leaves must be continuously wet for several hours before this takes place. It is, therefore, only when we have a day or two of rain or heavy fog that the fungus spores are scattered through the orchard and infection takes place.

About ten to eighteen days after the spores from the fallen leaves have infected the leaves or young fruit, the first scab spots of the season are observed. These, if examined with a microscope, are found to be composed chiefly of spores and fungus threads. These spores are produced on little stalks right on the surface of the scab spots, the fungus having developed under and pushed off the outer layer (cuticle) of the fruit or

leaf. If the weather is dry and warm they can do no harm as moisture is necessary before they can be scattered freely and germinate, but if a period of wet weather comes the spores on the scab spots are scattered by rain and wind-borne rain, and infect the leaves or fruits and in ten days or two weeks another crop of scab spots is developed. If the weather is wet the spores from these may in turn give rise to more scab spots, so that there may be several successive generations of these spores during a wet season. In seasons of average weather conditions for Ontario, the period when most infection occurs is from the time when the blossom clusters are pushed up in the buds until about twe weeks after the petals fall. Infection, however, may occur earlier than this—when the fruit buds are bursting. In some seasons serious infection may also occur later, about the end of June. May and June are nearly always the months in which there is the greatest danger of scab becoming serious. During July and most of August the scab fungus can rarely develop because at this time of the year there is not sufficient continuous moisture as prolonged wet periods seldom occur, and the days are long and the nights comparatively short and warm, so that the leaves and fruits are quickly dried even after heavy showers. In August and September, however, prolonged cool wet weather may occur and at this time there is danger of late infection.

Prevention—Apple Scab can be prevented by timely and thorough spraying in combination with the proper pruning of the trees. It is all important that spraying should be done at the right times. The spray mixture must be on the leaves and fruit before the spores reach them. We have already learned that the spores are scattered and develop only during wet weather. The times of the year, therefore, when we get our wet weather, are the times we have to spray if we are going to prevent scab. One spraying with either lime sulphur or Bordeaux mixture is not sufficient, as the rain gradually washes the spray off and as the leaves and fruit, by growing larger, develop more surface to cover. In order to be sure of preventing the disease we must spray from three to six times during the season, the number of sprayings depending upon whether the weather is wet or dry. Four applications are given usually every year, namely: the early leaf and pre-pink spray, the pink spray, the calyx spray, and the small apple spray.

Early Leaf and Pre-Pink Spray—This spray should be given between the time when the fruit buds on most varieties have clearly burst and the

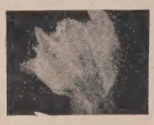


Fig. 1.

Fig. 2—Early-Leaf and Pre-Pink Spray.

time when the blossom bud clusters have begun to push up in the buds. It is usually advisable to commence spraying when the fruit buds on most varieties have clearly burst. (Fig. 1.) Try to cover two-thirds of

each tree from the one side at this stage. Spray the other side as soon as the blossom bud clusters have begun to push up in the bud on most varieties. (Fig. 2.) Try again to cover two-thirds of each tree. If the weather is wet or rain threatening at either of the above stages spray both sides of the tree. For this spray use either Bordeaux 3-6-40 or lime sulphur, 1 gallon to 40 gallons of water (sp. gr. 1.007-1.008). If cigar-case bearer or bud moth is abundant add 1½ pounds of arsenate of lead to the mixture.

Pink Spray—This should be given when most of the blossoms are showing pink. At this time use lime sulphur, 1 gallon to 40 gallons of water (sp. gr. 1.007-1.008) and add 3 pounds of hydrated lime and either 1½ pounds of arsenate of lead or 1 pound of calcium arsenate to every 40 gallons of the spray. The ideal time to apply the pink spray is just

Fig. 3—Pink Spray.

after the blossom buds have separated (Fig. 3), but in a cool, wet season it is not safe to wait until this stage is reached. In such a season spray one side of the tree after the blossoms are showing pink but before they separate and spray the other side immediately after they separate. If the blossoms open before this spraying is completed, omit the poison and finish the application.

Calyx Spray—This should be given immediately after the blossoms have all or nearly all fallen (Fig. 4.) For this application use lime sulphur,

Fig. 4—Calyx Spray.

1 gallon to 40 gallons of water (sp. gr. 1.007-1.008), and 1½ pounds of arsenate of lead and 3 pounds of hydrated lime. Always put the lime in the tank before adding the poison. This is generally a very important spray

in the control of apple scab and always the most important application in the control of codling moth. It must be promptly applied as a delay of a day or two may make all the difference between success and failure. In order to control the codling moth the calyx cups of the little apples must be filled with poison. This means that the spraying must be very thoroughly done. If the trees are large it is advisable to have a tower or support on the tank in order to do thorough work, as it is necessary to reach all parts of the tree and to have the spray mixture carried through the tree from one side to the other as a fine mist, if it is going to reach all the small fruits.

Small Apple Spray—This should be given about twelve days after the calyx spray to all trees with fruit on them. At this time use lime sulphur, 1 gallon to 50 gallons of water (sp. gr. 1.006). Apply in the form of a fine mist for fear of injuring the foliage. This spraying can best be done from a tower or the top of the spray tank. No poison need be added at this time, if a special spray about two weeks later is to be given for sideworms or apple maggots. Otherwise add 1 pound of arsenate of lead to every 40 gallons after putting in 3 pounds of hydrated lime.

Late Applications for Scab in Wet Weather—The best insurance against late attacks of scab is thoroughness in the first four sprays. If, however, owing to very moist cool weather in early August, a late attack is feared, spray with lime sulphur alone, 1 gallon to 50 gallons of water (sp. gr. 1.006), not later than August 15th. Spray from tower or top of the tank and apply as a fine mist. Do not spray on a hot calm day for fear of sunscalding the fruit.

It is necessary to vary somewhat from year to year with weather conditions the exact time of these various applications, the object being so to time our sprayings that the new growth will always be covered with the spray mixture during prolonged wet weather. To accomplish this it is necessary to study the weather conditions and forecasts each season so that we can make our application just at the right time to do most good.

Black Rot Canker, Black Rot and Leaf Spot, (*Physolospora cydoniae*, Arnaud).

Black Rot Canker on branch.
(Original.)

This disease is found in most parts of the Province, and is worst generally in poorly cared for and neglected orchards. In the apple-growing districts east of Toronto it has caused serious injury to apple trees and much alarm to the growers. In that part of the Province, however, it is not by any means confined to neglected orchards. Observations and experiments show that the fungus causing Black Rot Canker is unable to penetrate healthy bark, and can gain entrance and produce cankers only through wounds owing to various causes, such as winter injury, sunscald, carelessness in cultivation, pruning and picking of the fruit. Varieties of apples which are most susceptible to Black Rot Cankers are those which are too tender for the district and so suffer severely from winter injury and sunscald.

The fungus which causes Black Rot Canker is not confined to the apple. It is recorded as affecting pear, quince and other trees, but the writers have not observed it at least to any appreciable extent in Ontario on any host but the apple.

Symptoms—This disease affects the trunk, branches, leaves, fruit and sometimes the twigs. It causes most damage by the cankers produced on the trunk and larger limbs. On the leaves circular spots from one-eighth to one-quarter of an inch in diameter are produced. These are brown in the centre, with a distinct purplish margin. Towards the centre of these spots the minute black fruiting bodies (pycnidia) of the fungus can often be seen by a careful observer. The leaves are seldom severely injured by these spots, but frequently they are plentiful enough in unsprayed orchards to attract the attention of the grower.

On the fruit a small brown spot first appears. This gradually increases in size until the whole fruit becomes rotten, brown, and later black. The surface becomes covered with minute black fruiting bodies (pycnidia), which helps to give to the rotted fruit a black appearance. For some time the affected fruits remain firm and retain their normal form, but finally shrivel. These black, shrivelled fruits are frequently seen hanging on the trees or lying on the ground beneath. In Ontario, the rotten fruit in the orchard is not abundant and is seldom noticed by the grower except

on Alexanders. In storage also, so far as our observations go, the Black Rot on the fruit attracts but little attention.

On the trunk and larger limbs discoloured areas appear on the bark. These may increase in size, forming large cankers, which with age become cracked, rough and black. These cankers may be only a few inches long, or they may be a yard or more in length. They are usually found on the southwest side of the trunk and on the upper side of the larger limbs, these being the parts of the tree that are most likely to suffer from sunscald and winter injury. In many cases the cankers gradually enlarge, extending completely around the trunk or branch, and penetrating through the bark to the wood, thus girdling the part attacked. The cankers in this way frequently destroy the larger limbs, and, when they occur on the trunks, which they very often do, may cause the death of the whole tree. Sometimes the cankers remain small. Frequently even the larger ones do not penetrate deeply, and cause merely a superficial roughening of the bark, which in time may disappear. Embedded in the bark of the cankers small, black, pimple-like structures may be seen with the naked eye. These are the fruiting bodies (pycnidia) of the fungus.

Life History—The fungus causing this disease is carried over the winter chiefly in the form of dormant fungus threads (mycelium) in the cankers and immature spore cases (pycnidia) which are seen in abundance as little black specks in the skin of the rotted apples, the bark of the cankers and to a less extent in the spots on the leaves. In these spore cases numerous spores (pycnospores) develop which mature and are discharged during the spring and early summer. A second form of spores (ascospores) are sometimes developed in fruiting bodies (perithecia) embedded in the bark of the cankers. It is also probable that some of the spores discharged from the spore cases (pycnidia) in the summer, winter over in the crevices of the bark. As has been stated before, observations and experiments have shown that infection can only take place through wounds in the bark, the spores being unable to infect sound and healthy tissue. Winter injury, sunscald, carelessness in cultivation, pruning and picking of the fruit, or other causes make wounds through which the fungus gains entrance into the bark and finally spreads and causes cankers. Varieties which suffer from winter injury and sunscald are very subject to Black Rot Canker because it is chiefly through such wounds that the fungus gets a start in the healthy bark.

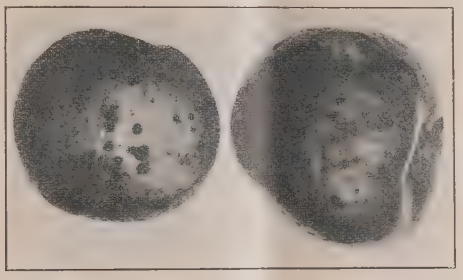
Treatment—Plant only those varieties which are known to be hardy in the district where they are to be grown. Keep the trees thrifty by proper pruning and cultivation. In districts subject to extreme cold during the winter months, do not cultivate later than the middle of June, then sow a cover crop. Such treatment will check the growth of the trees and cause the wood to harden for winter. Cut out all cankers on the trunk and larger limbs, except those that are merely superficial. Use a drawknife for this purpose and cut back to healthy bark, taking care to leave the edges of the wound smooth, even and perpendicular. Wash the wounds thoroughly with concentrated lime-sulphur or with bluestone, one pound to ten gallons of water, and paint over with coal tar or white lead mixed with linseed oil without turpentine. White lead checks and cracks, and if it is used the wounds will have to be painted over two or three times. Coal tar does not check or crack, but slightly discolours the bark around the edges of the wounds. The writers, however, have never noticed any serious injury to the bark from the use of coal tar on apple trees. Badly cankered trees, which would be dead in a year or two if neglected, can

in many cases be saved by cutting and treating the cankers as described above. In pruning it is often advisable to cut out and burn large limbs which are badly cankered, if this can be done without causing too much injury to the tree. Sometimes, when it is necessary to remove a badly-cankered main limb, a sucker nearby can be left to grow and take its place. Proper spraying is also of importance in controlling this disease.

Spray the trees as recommended for the prevention of Apple Scab. Give special attention to the first application and take care to see that the trunk and main limbs are thoroughly covered with the spray mixture at this time.

Sooty Blotch [*Gloeodes pomigena,* (Schw) Colby].

This disease sometimes disfigures apples and by so doing much reduces their market value. Spy and Greening appear to be particularly susceptible to it. It does not usually appear until late summer or early fall, and only becomes prevalent enough to cause serious disfigurement of the fruit when the weather is exceptionally wet at this time of the year.



Sooty Blotch. (Original.)

Symptoms—The disease is easily recognized by the characteristic irregular sooty blotches which the fungus causes upon the fruit. These may be few and scattered or numerous and often coalescing so as to give a sooty appearance to a considerable area of the surface of the apple. Affected fruits are disfigured and rendered unattractive but the flesh is not injured as the fungus does not penetrate below the skin.

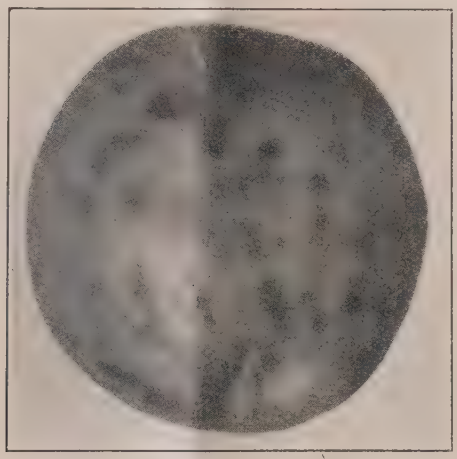
Prevention—Prune the trees to let in plenty of light and air as Sooty Blotch is always worse where the dense foliage keeps the fruit damp for a long time after showers and heavy dew. Spray the trees as recommended for the prevention of Apple Scab. In a very wet fall the late or August spray is important in the control of this disease. (See directions for spraying to prevent Scab).

Stippen, Baldwin Spot or Bitter Pit.

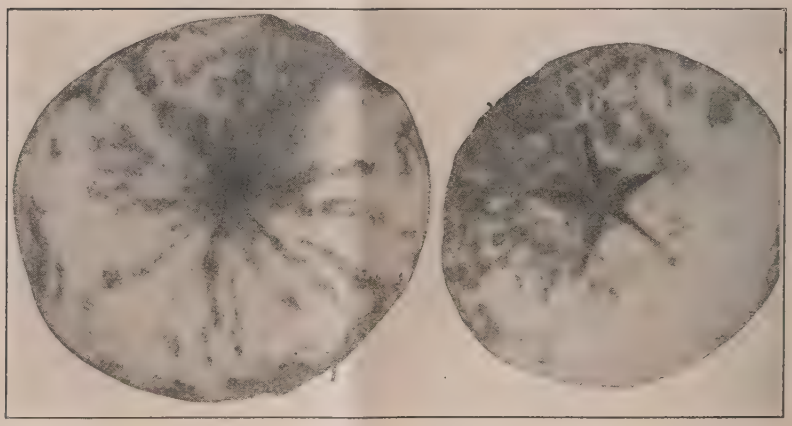
This disease is frequently seen in Ontario. The Baldwin and Spy are particularly subject to it, but it is by no means confined to these varieties.

Symptoms—Small, sunken, dark spots, from one-sixth to one-quarter of an inch in diameter are seen on the surface of the fruit. The skin of the spot is usually unbroken. The flesh beneath is dead and brown, and frequently similar brown spots and streaks are scattered through the

interior of the fruit. Very often apples may be badly affected in this way without showing the characteristic pits on the surface. This form of the disease may be referred to an internal stippen. So far as one can judge, it occurs early in the growing season and is mistaken frequently for the work of the Apple Maggot, which it resembles to some extent. Occasionally fruits may be deformed, due to the extreme development of internal stippen. Frequently, apples apparently sound when picked, develop the external form of the disease in storage.



Stippen or Bitter Pit. (After McAlpine.)



Internal Stippen. (Original.)

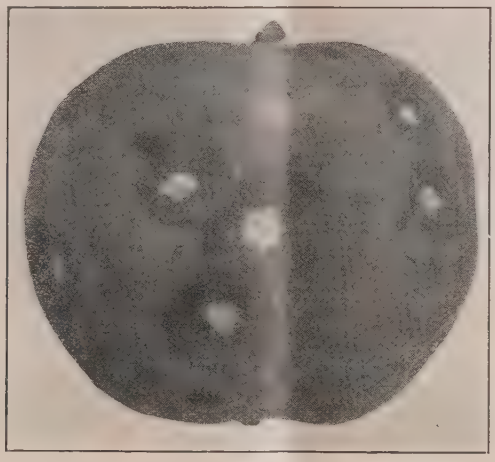
This disease is not caused by any fungus, bacterium or insect. Authorities agree that Bitter Pit is chiefly due to a disturbed water relation. The conditions tending to the production of Stippen or Bitter Pit appear to be, first: extreme variation in the water supply to the trees during the growing season which tend to check and stimulate alternately the growth of the fruit; second, soils of poor physical or mechanical condition, especially those lacking sufficient humus and having a poor water-holding capacity; third, trees which produce a light crop of over-size

fruits; fourth, heavy pruning or a system of pruning which causes the fruit to be produced on the main limbs rather than on well-distributed laterals.

Prevention—So far as is known very little can be done to prevent this disease beyond adopting those horticultural practices which tend to an even normal development of the fruit throughout the season. Such practices include, first, the increasing of the water-holding capacity of the soil by the liberal use of manure or by the use of cover crops suitable to the locality; second, cultivation or mulching to ensure moisture and equalize the available supply throughout the growing season; third, proper pruning so that the crop is evenly distributed over the tree and balance maintained between the root system and the top; fourth, underdraining of the orchard, when there is any indication that it would help the trees.

Pink Rot (*Cephalothecium roseum* Cda.)

Pink Rot is chiefly a storage trouble, suceeding Apple Scab. It is found on scabby apples which have been packed during moist weather or stored in a damp place. The fungus which causes this rot cannot penetrate the sound skin of the apple, and can gain entrance to the flesh only through scab spots or other wounds. Greening and Snow are particularly subject to Pink Rot.



Pink Rot following Apple Scab. (Original.)

Symptoms—A whitish mould sometimes with a distinct pinkish tinge develops around or upon the scab spots. This is followed by a brown rotting around the spots, which markedly disfigures the fruit and renders it unpalatable.

Prevention—Spray thoroughly to prevent Apple Scab. Pink Rot never causes serious injury except to scabby apples. In packing, discard any fruits showing signs of white mould. Store the fruit in a cool dry place as soon after picking as possible. If possible pick and pack when the weather is cool and dry.

PEAR BLIGHT, (*Bacillus amylovorus*, Burrill).

This destructive disease is usually known by the above name, but fruit growers speak of it also as Blight, Fire Blight, Twig Blight, Blossom Blight, and, when it infests the trunk, as Body Blight.

It attacks not only pears, but also apples, crab apples, quince, mountain ash, hawthorn and juneberry. The last three are rarely much affected, but pears, apples, crabs and quince suffer severely in seasons favourable for the development of the organism. So destructive is the Blight to pears that many good orchards have been almost totally destroyed by it; in fact so great has been the loss that in many districts fruit growers have given up pear growing in the belief that they cannot successfully cope with the disease. Apples do not suffer so severely as pears, yet some varieties, even of large, bearing trees, are much injured, and young, rapidly growing trees of very susceptible varieties are not infrequently killed. All varieties of quince are much damaged by the killing of branches and twigs, though the trees themselves are not often killed.

Young pear orchard in early spring, showing blighted branches. The presence of the leaves indicates where the disease is. (Original.)

The disease is found in nurseries as well as in orchards.

There is a great difference in the relative susceptibility of the various varieties both of apples and pears to attack. It is generally agreed that Clapp's Favorite is the most susceptible pear. Flemish Beauty and Bartlett are also quite susceptible, whereas Kieffer is least affected and Seckel is rarely severely attacked. Of apples, Alexander is usually the most susceptible and after it King, Tolman, Gravenstein and Rhode Island Greening. Among those least susceptible to infection are Spy, Duchess, and Ben Davis. No variety, however, either of apple or pear, is entirely exempt, especially from infection through the blossoms, even Kieffer pears often having many blossoms blighted.

Symptoms—The disease manifests itself in several ways.

(1) In early June soon after the blossoms have fallen we often see the fruit clusters and the leaves immediately surrounding them wilting and dying, and in a few days turning brown on apples and nearly black on pears. There may be hundreds of such diseased twigs or fruit spurs

on a single tree. This stage of the disease is usually called Blossom or Twig Blight and is caused by the organism having been introduced into the blossoms by insects or by driving rains and becoming established there.

(2) Throughout the remainder of the season it is common to find watersprouts, suckers and branches of various sizes dying. The leaves on these usually do not drop but remain attached for months and sometimes even through the winter. Most of these later infections can be traced back directly or indirectly to the Blossom Blight mentioned above.

(3) Not infrequently the trunks and main branches become infected either as the result of the disease working down from smaller branches

Blighted twigs on pear trunk. The disease runs down such twigs and enters the trunks or branches. (Original.)

Main limbs of a Flemish Beauty pear tree, O.A.C. orchard, in which the blight is rapidly spreading. The limb to the right is practically dead. Notice the cracking and blistering of the bark, especially on the middle limb. All the disease above the crotch developed this season from the cankered area below the crotch. It spread throughout the bark very rapidly during June, July and August. Photo taken in September. (After Jones.)

or from its getting into a watersprout and running down this into the trunk or branch, or from direct inoculations by some bark or wood-infesting insect that had just previously fed upon a diseased part of some tree. All these cases are often spoken of as Body Blight. Roots of trees may also become inoculated through infected suckers, the disease running down these into them. On pear trees, infections of the trunk or main branches or roots are likely to mean the death of the trees unless the affected areas are promptly cut out and disinfected. But on apples, such infections usually live for only a few weeks and then die, though they often leave a

dead area or canker varying in diameter from one to several inches. Very susceptible and succulent young apple trees are, however, sometimes killed outright by Body Blight.

(4) Occasionally the fruit becomes infected and is destroyed; but the total loss of fruit from this cause alone is small.

Cause of Blight—The disease is caused by a very tiny bacterial organism, known as Bacillus amylovorus. This is so small that at least 10,000 individuals could find room on the head of a pin. These germs work chiefly in the tender tissues of the bark and have marvellous powers of multiplying; millions may be produced from a single one in a day. They feed on food substances present in the living bark and soon kill the part attacked. Warm, moist weather, which causes rapid growth and a succulent condition of the bark favours greatly their development; whereas drought by checking the growth and thus lessening the succulence of the trees and especially of the bark soon checks the progress of the disease and in many cases even destroys the organism itself. There seems, in fact, no reason to doubt that the variation in the amount and virulence of the disease over large areas one year compared with another must be attributed chiefly to the difference in the sort of weather that prevailed, though no one has yet been able to analyze fully all the effects of weather.

Means of Distribution—During the winter the Blight organism lives in the healthy bark that bounds the dead areas. In spring when the sap begins to move through the trees the germs begin to multiply and by the time the blossoms are opening, sometimes clog the tissues of the bark to such an extent that a sticky fluid containing countless germs breaks through to the surface. If this exudate happens to be high up on the tree driving rains will dilute it and carry the germs to blossoms below either on the same tree or on neighboring trees. Then bees or other insects visit these inoculated blossoms and spread the disease to other blossoms and inoculate these, and from them in turn thousands of blossoms here and there throughout the orchard may become diseased.

Another method of spread is through ants, which often feed upon the sticky exudate wherever it may be and thus get their mouth parts and feet covered with germs. These same ants a little later visit the blossoms to feed upon the nectar and thus inoculate them. Other insects as well as ants may act in this way. Then the bees, wasps and other bloom-frequenting insects visiting these same blossoms carry the germs to other trees.

After the blossoms have fallen and the disease has become well started on the twigs and fruit spurs, sucking or biting insects, such as aphids or bark beetles, which may happen to feed upon a diseased leaf or twig, can carry the germs on their mouth parts to new twigs and inoculate them. The chief time of distribution in an average year is during the blooming season, but some goes on all through the growing season.

Methods of Control—The first step in control is to put the right man in charge of the work; for only a careful, observant and interested person is likely to make a success of it.

The second step—the one on which the success of the work will chiefly depend,—is to cut out and burn during the winter or early spring and never later than April 1st all diseased pear twigs and branches and to remove all the bark over any local diseased area on the trunk or main branches. Trees of course, in which the crotch or trunk is so badly diseased that there is no hope of saving them should be totally removed

and burned. The object of this destruction of all diseased trees and parts of trees at this time of the year is to remove as far as possible all sources of later infection, especially infection at blossom time. Any person who fails to do this early cutting and burning is going about the work in a wrong way and need not expect to control the Blight in a year favourable for its development.

An inexperienced operator will at first have considerable difficulty in detecting some of the diseased areas on the trees, especially where these are on the trunk or main branches and the part above still looks healthy. Hence he should first go through the orchard and remove all the branches whether large or small that he can plainly see have been killed by the disease and in so doing observe the colour of the bark on these and how it differs from healthy bark. He should also note that on some of the larger branches diseased bark will not only be darker but also be swollen, more or less spongy and sometimes ruptured in many places. In this way he will soon get his eyes so well trained that he can readily pick out diseased areas anywhere, though certain shrunken places on the bark may at times give him trouble. These places are often in no way connected with Blight and are characteristic of pear trees. By cutting them through with a knife and observing that the wood beneath the inner bark is healthy he will be able to recognize that they are not diseased; for if Blight were the cause the bark and also the wood immediately beneath would either be dead or there would be reddish brown streaks present.

When the blighted branches are being removed they should always be cut a few inches below the limit of the dead area, because the disease germs, as stated above, winter over not in the dead bark but in the living bark adjoining the dead. In the same way when cutting out any dead area on the trunk or main branches, it is necessary to remove the living bark all around it as far back as there is any sign of the reddish-brown streaks; for such streaks are an indication of the presence of the disease.

The most convenient tools the writer has yet found for cutting out dead or diseased areas in the bark are a sharp drawknife and a stout jack-knife. A saw and a long-handled pair of pruners are good tools for removing branches and twigs. It is convenient of course, to carry along also a pair of small hand-pruners.

Very few men, even though experienced, will be able to see and remove all blighted parts by merely going over an orchard once. The writer found it was always wise to go over every tree twice and in some cases three times. This is specially true when the operator is inexperienced.

No disinfectant is necessary in this early cutting out of diseased parts, provided the work is finished before the sap begins to move through the trees in spring.

The third step—in control of Blight is to watch for the first indications of Blossom Blight and remove the affected twigs as soon as they show infection. Blossom Blight begins to appear about a week or a little later after the blossoms have fallen. The first indication of it is the wilting of the leaves around the little fruit clusters.

In order to prevent the disease from running down the infected twigs or fruit spurs into the main branches and thus making it much more difficult to treat, it is necessary to remove the twigs as quickly as they show by their wilting that they are infected. *Not a day should be lost in doing this.* The easiest and best method is to drive a truck or dray close alongside each tree and from it or from the ground or a step-ladder, break off every diseased twig or fruit spur. It is much safer and quicker to break

them off by hand than to cut them off, because in breaking there is no danger of spreading the disease and no need of using a disinfectant. All the twigs will not show the disease the same day so it will be necessary to go over the trees about three or four times at intervals of a day or two to make a thorough job. So far as practicable the broken off twigs should be thrown on the truck or wagon and hauled off and burned. If this removal of the Blossom or Twig Blight is done promptly and thoroughly there will be very little further difficulty the rest of the season, though it will be necessary about once a month to look over the trees and remove any branches that have later become infected. In cutting these out it is very important to make the cut at least six inches or if possible a foot or more below the lowest sign of the disease on the bark, because the disease may have advanced several inches in the bark without showing any external evidence. If the branches are short examine the bark at the base and remove it as far as it shows any indications of disease being present.

Disinfectant and Methods of Using It—Corrosive sublimate, 1 part to 500 parts of water, was for a long time the disinfectant used, but recently is has been found that a better disinfectant is 1 gram corrosive sublimate and 1 gram of mercuric cyanide to 500 cc. of water. If there are many trees in the pear orchard at least half a gallon of this should be made up at a time by a druggist and kept in an earthen or glass vessel as it injures metals. The simplest method of using it is to carry along a bottle-full with a piece of sponge in the top instead of cork. Turn the bottle upside down until the sponge is wet then after each cut rub the wet sponge over the surface of the cutting tool and also of the cut on the tree.

Caution—This mixture is a deadly poison, and should be so labelled.

All cuts made in the growing season must be disinfected otherwise the saw or other cutting tool will soon become infested and will thus spread the disease.

A fourth helpful step in control is to remember that the disease often gets into the trunk and main branches by running down watersprouts and into the roots through suckers; hence it is a good plan to go through the orchard occasionally and rub off with the thumb all watersprouts while still small, and cut off below the surface of the soil all suckers.

A fifth measure—is not to encourage great growth and succulency of trees, because this favours the disease. Hence after the trees have begun to bear or to blossom do very little pruning and either grow them in a sod mulch or else lessen the amount of cultivation and of fertilizers.

It is also well in setting out new orchards not to plant Clapp's Favourite or the Alexander apple because of their great susceptibility to Blight and the menace they therefore are to the rest of the orchard. It is also wise as a rule not to plant apples and pears in the same orchard.

In conclusion it may be said that quince and young apple trees may be treated for Blight in the same way as pears but that on large apple trees the cutting out of Blossom Blight is impracticable and not so important, because usually the disease dies out before entering the main branches or else soon after it enters. Where old apple trees are heavily blighted cease cultivation and put them into a sod mulch and try to remove all diseased branches as on pears in winter or early spring.

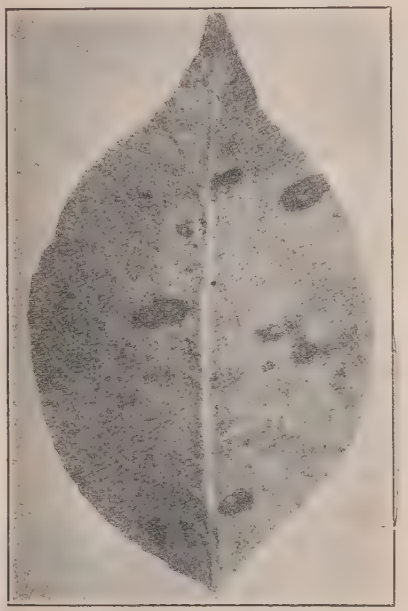
NOTE—For a much fuller account of this disease see bulletin No. 342, by Prof. D. H. Jones.

Pear Scab (*Venturia pyrina*, Aderh.)

Pear Scab is similar in nearly every respect to Apple Scab. In Ontario only the Flemish Beauty and a few of the less valuable and often unnamed varieties of pears are very subject to it. Scab is a great drawback to the otherwise valuable variety, Flemish Beauty. When the fruit is badly affected it is cracked open and rendered almost valueless for commercial purposes.

Life History—Very similar to that of the fungus which causes apple scab except for the fact that this fungus is carried over on the twig to a much greater extent.

Pear Scab on fruit. (Original.)



Leaf Spot on pear. (After V. B. Stewart.)

Prevention—The Flemish Beauty pear and other varieties very subject to scab should be sprayed with Bordeaux, (3-6-40), first as the buds are bursting, second just before bloom, third just after the blossoms fall, and fourth in ten days. In very wet weather additional applications may be needed. It is advisable to take special care with the first spray to see that the tips of the twigs are covered. Most varieties of pears require only one application for the control of scab. This should be given soon after the blossoms have fallen with Bordeaux (2-4-40), and either 1½ pounds of arsenate of lead or 1 pound of calcium arsenate to every 40 gallons. A special spray with 3 per cent. lubricating oil emulsion in late March or early April is necessary to control pear psylla (see spray calendar).

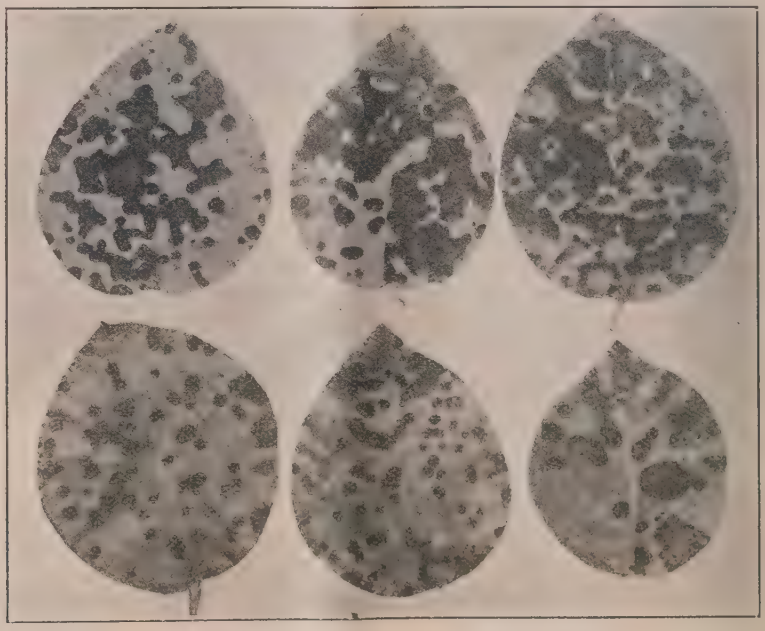
Leaf Spot of the Pear (*Mycosphaerella sentina* (Fr.) (Schröt).

This disease is frequently seen in Ontario, though it seldom causes any appreciable harm except in badly neglected orchards or to trees growing wild on roadsides or in fence corners. It is sometimes observed in nurseries and occasionally results in premature defoliation which checks the growth of the young trees.

Symptoms—The disease is confined to the leaves, on which are seen small, somewhat angular spots, usually with grey centres and brownish or purplish-brown borders; but sometimes the whole spot is dark in colour, with no distinct grey central area. In the centre of the spots as they mature, small black specks, the fruiting bodies (pycnidia) of the fungus, appear. The size of the spots appear to vary with the variety and the season. When the disease is severe the spots may be so numerous as to injure the leaves markedly.

Life History—The tiny black specks or fruiting bodies (pycnidia) are filled with minute, slender, thread-like spores, which are discharged from a small opening at the tip of the fruiting body (pycnidium). They are scattered through the orchard by the wind and rain, and serve to spread the Leaf Spot during the summer months. Moisture is essential for the germination of these spores and for the penetration of the leaf by the germ-tube. Hence it is that the Leaf Spot is always most prevalent in a wet season. The fungus lives over the winter in the fallen leaves. In these another form of spore (ascospores) is developed in a special kind of fruiting body (perithecium). These are discharged in the spring of the year and some of them are blown by the wind to the newly developed leaves on which in a short time they produce the characteristic spots and the first generation of summer fruiting bodies (pycnidia).

Prevention—The sprayings which are given for Scab appear to control completely Leaf Spot. To control it on nursery stock spraying with Bordeaux mixture (3-6-40) or with commercial lime-sulphur 1 gallon to 40 gallons of water is recommended. The first application should be made just as soon as the trees come into full leaf in the spring, the second about two or three weeks later. In very wet seasons one or two more sprayings at intervals of about two weeks may be necessary.



Leaf Blight of quince. (V. B. Stewart.)

LEAF BLIGHT OF PEAR AND QUINCE (*Fabraea maculata*, (Lev.) Atk.)

This is another disease of comparatively little importance in Ontario. It is seen on both pear and quince, but is usually more noticeable on the latter. It is chiefly a leaf spot disease, but the fruit is sometimes also affected. The spots on the leaves are small circular, dull red or brown in the centre with darker borders. One or more black pimples, fruiting bodies (pycnidia), of the fungus can be seen in the centre of each spot. In severe attacks the spots may be so numerous that the leaves turn yellow or brown and fall. Red and brown spots are sometimes also seen on the fruit. On the quince the disease is sometimes so severe as to cause a premature defoliation.

Prevention—In orchards the sprayings as ordinarily given for Scab appears to control completely this disease on pears. On quinces it may be prevented by spraying with lime sulphur or Bordeaux mixture. Spray with commercial lime sulphur 1 gallon to 40 gallons of water (home boiled lime sulphur sp. gr. 1.007-1.008) or Bordeaux mixture (3-6-40). Give the first application shortly before the blossoms appear and the second soon after they fall. In a wet season a third spraying may be required about ten days later.

PEACH LEAF-CURL (*Exoascus deformans* (Berk.) Fckl.)

This is the most common and most injurious fungus disease of the peach. It is familiar to every peach grower and very frequently seriously impairs the vitality of his trees.

Symptoms—Blossoms, young fruits and twigs are sometimes affected but it is by the destruction of the leaves that the chief injury is done. The leaves are usually infected before they emerge from the buds in the spring. They become distorted, curled, thickened and yellowish-white, pinkish or purplish in colour. A little later in the season they turn brown and fall. The disease may spread from the leaves into the shoots and destroy them. In severe attacks of Peach Leaf-Curl the trees are almost completely defoliated, the fruit is stunted or drops to the ground, and the vitality of the trees is so impaired that they are likely to be severely injured by the cold the following winter. The proper development of fruit buds is also prevented. Young trees may be killed the first year they are set out if they are defoliated before they have recovered from the shock of transplanting. Peach Leaf-Curl is always more severe in cold wet springs.

Life History—On the surface of the affected leaves numerous spores are produced and the fungus which causes Peach Leaf-Curl is thought to be carried over the winter by some of these spores adhering on or between the bud scales. In the spring, when the buds begin to swell with warmth and moisture, the spores germinate and infect the unfolding leaves. Hence the necessity for early and thorough spraying. In cold wet springs the opening of the buds is retarded, while the germination of the spores and the development of the fungus is favoured by the excessive moisture and not retarded by the cold. Thus the fungus has plenty of time to get established in the tender tissues of the developing leaf. This explains why Peach Leaf-Curl is always worse in cold wet springs.

Prevention—Spray in March or early April before any buds swell, with lime sulphur 1 gallon to 15 gallons of water (sp. gr. 1.020) or with lubricating oil emulsion and (3-6-40) Bordeaux mixture. Spraying must be done early in the spring before the buds have started to swell, and care must

be taken to see that every bud is thoroughly covered. Success depends upon early thorough spraying as can be understood from a consideration of the life history of the fungus. Fall spraying for the prevention

Peach Leaf-curl.

of Peach Leaf-Curl has been tried in Ontario and although it does prevent the Curl we cannot recommend it as it appears to make trees more liable to winter injury.

Peach Yellows and Little Peach.

These two diseases are closely associated in the orchard and seem to be so nearly related that they may be discussed together. They are both very destructive and are much feared by all peach growers who have had an opportunity to see the damage they can do. From about the year 1909 to 1913 these diseases were so prevalent in the Niagara district that there was something like a panic among the growers lest the peach industry might soon be ruined. At that time the writer saw several otherwise excellent orchards varying in size from 500 to 1,000 trees, in which almost every tree was diseased and thus worthless; for there is no cure for a tree once it is diseased. Some of these orchards were not more than eight years of age, and so had not reached their prime. Fortunately, a better knowledge of the symptoms of the disease and better inspection have since brought both under control.

Symptoms of Peach Yellows—On a diseased tree some of the fruit will usually ripen from a few days to two or three weeks prematurely.

Such fruit is usually more highly coloured than normal, is often blotched outside with red, streaked inside with the same colour and has the flesh around the pit abnormally red. It may also be knobby. Sometimes only one branch or even one twig will show these symptoms and all the rest of the tree bear quite normal fruit. The first year the diseased fruit is either normal in size or a little larger, but the next year it is smaller than normal. The foliage on at least some of the branches is nearly always a sickly yellow colour and is often clustered and curled as described below for Little Peach. Sometimes we find arising from the main branches little upright tufts of much-branched twigs with narrow, yellowish leaves. These broom-like growths, however, are not common except on trees in which the disease is in an advanced stage.

Branch of tree affected with Little Peach just beginning to show the clustering and curling of the leaves near the base as indicated by the arrows. (Original.)

Symptoms of Little Peach—The fruit on a typical diseased tree or part of a tree ripens later than usual, and is smaller than normal, but has no peculiar colour markings. In many cases, however, we find trees on which the fruit ripens at the usual time and is about normal in size, and yet the foliage shows clearly that the trees are diseased. The symptoms on the foliage are the curling and clustering of the leaves, *especially on the inner parts of the tree,* and the sickly yellowish or often reddish-yellow colour they assume. On some varieties the leaves cluster much more than on others. Curling and clustering of leaves apart from the yellowish colour is not a symptom of the disease. On young diseased trees the leaves on the outer branches will usually remain quite green for a long time after those on the inner or central portion have begun to show the disease. If the centre of the tree looks healthy but the outer branches because of a reddish-yellow colour, look diseased, it will nearly always be found that such trees are not affected by Little Peach or Yellows, but are suffering from lack of nourishment. Care must of course be taken

both with Yellows and Little Peach not to confuse the foliage symptoms of these with those caused by winter injury or by borers at the base of the tree or by cankers on a branch or elsewhere. A little study and experience will soon enable a person to recognize injuries from these causes. It is also worth remembering that the foliage on the Crawford type of tree differs from that on the Elberta, and the latter again from that on the Smock or Triumph or St. John; so that to study Yellows and Little Peach one should first familiarize himself with the different kinds of foliage to be found on the different varieties. This is especially important as the amount of curling and clustering due to these diseases depends largely upon the sort of leaf characteristic of the particular tree affected.

Cause—The cause of Yellows or Little Peach has not been discovered. There are, of course, several theories, but none is satisfactory. No or-

Leaves from Little Peach tree, showing the characteristic flattening and curling. (Original.)

ganism, whether bacterial or fungus, so far as the microscope or as cultures are able to reveal it is present. It is believed, however, to be caused like mosaic diseases by a virus of some kind.

It has been shown both in our own experiments and in those of several investigators in the United States, that these diseases can be produced in healthy trees by budding them with buds from infected trees. We have done this in many cases, both on large and small trees, and in the vast majority of instances, though not in all, the disease has developed. In all but one case in our experiments it required two years from the time the buds were inserted before the symptoms could be detected on the foliage or fruit. Hence it is clear that in the tree itself development of the disease is very slow.

It has been claimed by several writers that pits from diseased trees will not grow. In our experiments this was true only of pits from badly diseased trees, but not of those from trees which had shown symptoms

of the disease only for a month or so. Of these, as high as eight per cent. germinated and grew.

It has also been claimed by certain writers that if a pit from a diseased tree grows, the tree thus produced will be diseased. We have had several hundred such pits grow and at the end of three years they showed no sign of disease. So that it would appear as if the danger from pits was not an important factor.

There is good reason to believe that whatever be the cause of Yellows and Little Peach, there is much danger of the disease in some mysterious way passing from one tree to another in the orchard. It is true that for several years this may not happen, and the explanation may possibly lie in the nature of the weather or absence of certain insects some years compared with others. In any case we can see no other explanation of the great increase of the disease in the past in orchards where infected trees were not removed than that these trees spread the disease to healthy trees. It is quite possible that, as in the case of mosaic diseases, aphids may be the spreading agents but this has not yet been proven.

Methods of Control—There is just one method of control, and that is to encourage the local inspector or the grower himself, to mark every clearly diseased and suspicious tree and take it out and burn it promptly. This in Ontario has resulted already in a very rapid decrease. In the Niagara district in 1911, 60,000 trees were marked and destroyed; in 1912 these were reduced to 25,000, in 1913 to 7,000 and in 1914 to 3,000. There are now about 1,000 trees removed each year for Yellows and Little Peach.

Nurserymen also can help to keep down the disease by special precautions not to take bud sticks from a diseased tree or even from any orchard where considerable disease has appeared at any time during the preceding three years.

It should be remembered that cutting out of the branches that show the symptoms is no cure; because once the disease is on one part of a tree it is also in every other part even though the symptoms may be absent.

Brown Rot of Stone Fruits.

(*Sclerotinia cinerea* (*Bon.*) Wor.).

This, as the name implies, is a disease of peaches, cherries, plums and apricots. It is to be seen in Ontario to a greater or less extent every year, and in some seasons causes very serious damage, especially to certain susceptible varieties of peaches, to sweet cherries, and several varieties of European plums.

Symptoms—Blossoms, fruits, leaves (sweet cherries), and twigs are affected. It is by the destruction of the fruit that the chief loss is caused. It first appears as a small, brown spot which gradually increases in size until the whole fruit becomes soft, brown and rotten. These rotten fruits retain their form for a time but finally they dry out and become shrivelled, hard and wrinkled and are known as "mummies." These are frequently seen hanging on the trees or lying on the ground underneath. On the surface of the rotten fruits greyish-brown, velvety spore pustules are easily seen with the naked eye. The fruit becomes more subject to rot as it approaches ripeness. Sometimes, however, the young green fruits are destroyed by the disease. The blossoms are sometimes attacked. They turn brown and fall. Blossom rot is quite common on cherries and

peaches in Ontario. Sometimes the fungus which causes the rotting of the fruit or blossoms grows back into the twigs and girdles them and thus causes a twig blight. This is most frequently seen in the case of certain susceptible varieties of peaches but is not uncommon on cherries and plums. On sweet cherry leaves, brown dead areas due to this disease are common when the rot is bad on the fruit.

Life History—The fungus which causes the disease is spread during the summer months by means of spores produced in great numbers on the surface of the rotting fruits. These are scattered by rain, wind, insects and other agencies. In warm, muggy weather the rot is spread by them very rapidly, especially when the fruits are close together and the foliage so thick as to keep out light and prevent the free circulation of the air.

The fungus which causes the disease is carried over the winter in various ways:—

Mummified plums and peach, due to Brown Rot. About one-half natural size. (Original.)

1. By means of the mummied fruits hanging on the trees or lying on the ground beneath. In these the mycelium of the fungus remains alive all winter and in the spring, when they are soaked by rains, the fungus threads may grow again and produce fresh crops of spores (conidia) on the surface. From some of the mummied fruits lying on the ground underneath the trees partly covered by the earth, about blossoming time, little trumpet-shaped growths (apothecia), are produced. These contain immense numbers of another kind of spores (ascospores), which are discharged into the air and may be blown up into the trees, where, if weather conditions are favourable, they may infect the blossoms or young fruit and cause them to rot. These trumpet-shaped growths (apothecia) have been observed in Ontario every year since 1912, and probably play an important part in initiating the disease in the spring.

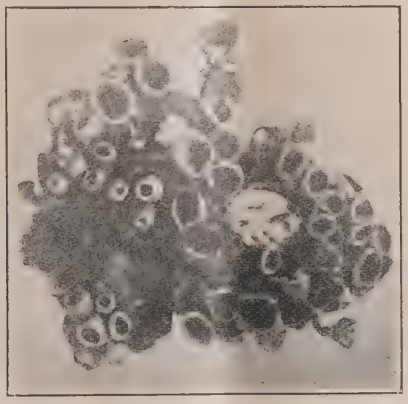
2. By means of spores produced during the summer adhering to the mummied fruits and probably to bark and bud scales. These retain their vitality and are capable of causing infection and producing disease again in the spring.

3. To some extent by means of dormant fungus threads (mycelium) in the blighted twigs.

It will be seen from the above account of the life history of the fungus, that the mummied fruits are chiefly instrumental in perpetuating the disease from year to year.

Prevention—Prune the trees so as to let in light and air and to facilitate spraying. Peaches should be sprayed first, in March or early April before any buds swell, using lime sulphur, 1 gallon to 15 gallons of water (sp. gr. 1.020) or 3 per cent. lubricating oil emulsion and (3-6-40) Bordeaux. Spray early varieties of peaches subject to Blossom and Twig Blight with Dry Mix (wettable sulphur) when the buds are showing pink. About a month before picking time spray all varieties with Dry Mix (wettable sulphur) or dust with sulphur two weeks before picking.

Cherries—Spray sweet varieties first, just as the buds are bursting, with lime sulphur, 1 gallon to 15 gallons of water (sp. gr. 1.020) and ½ pint of nicotine sulphate (40 per cent.) to 40 gallons, or use a 3 per cent. oil emulsion with (3-6-40) Bordeaux. On sour varieties use lime sulphur 1 gallon to 40 gallons of water (sp. gr. 1.007—1.008) or (3-6-40)



Spring stage of the Brown Rot fungus on a peach, buried just at the surface of the ground. (After McCubbin.)

Bordeaux. A second spraying should be given to all varieties when most of the shucks are off with lime sulphur 1 gallon to 40 gallons of water (sp. gr. 1.007—1.008), with 3 pounds hydrated lime and either 1½ pounds arsenate of lead or 1 pound arsenate of lime (calcium arsenate). Always put the lime in the tank before adding the poison. If the weather is very wet at this time substitute Bordeaux (3-6-40) for the lime sulphur to control Leaf Spot. A third spraying should be given as soon as the early varieties begin to colour with lime sulphur and poison as in the second spray. In wet seasons additional sprays are absolutely necessary for the prevention of rot. If the weather is very wet during blossom, spray at once with lime sulphur, 1 gallon to 50 gallon of water. Do not add any poison at this time. In a wet or very hot humid season spray again just before the fruit is ripe, using lime sulphur 1 gallon to 50 gallons of water, or the trees may be dusted with sulphur at this time. It is hardly necessary to add that no poison should be used with this application. This last spraying is of the utmost importance in some seasons to prevent sweet cherries rotting on the trees. It prolongs the picking period

for sour cherries and helps to insure their arriving on the market in good condition.

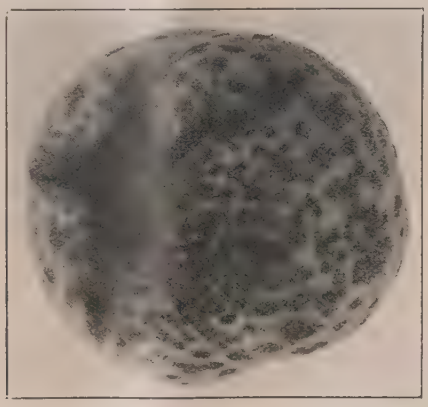
Spray plums first, before or as the buds are bursting, with lime sulphur 1 gallon to 15 gallons of water, or Bordeaux (3-6-40). If red mite or lecanium scale are troublesome add 3 per cent. oil emulsion to the Bordeaux. A second spraying should be given as soon as most of the shucks are off with lime sulphur 1 gallon to 40 gallons of water (sp. gr. 1.007—1.008). Add 3 pounds of hydrated lime and either 1½ pounds of arsenate of lead or 1 pound of arsenate of lime to each 40 gallons. Give a third spraying twelve days later with the same mixture as used in the second spray. Varieties of plums which are very subject to rot should be given an extra spraying about ten days before the fruit ripens with lime sulphur 1 gallon to 50 gallons of water (sp. gr. 1.006). No poison should be added at this time.

Peach Scab.

(*Cladosporium carpophilum*, Thum).

This disease has been very prevalent in Ontario during the past two or three years and in some orchards has caused very marked disfigurement of the fruit.

Symptoms—Small, circular, sooty-black spots are seen on the surface of the fruits. These may be scattered all over the surface or may be more or less confined to certain areas. In severe infections the spots may be so numerous as to disfigure badly the fruit and occasionally to



Peach Scab—a very severe infection. (Original.)

cause cracking. Twigs and leaves are sometimes affected, but seldom to a noticeable extent in Ontario.

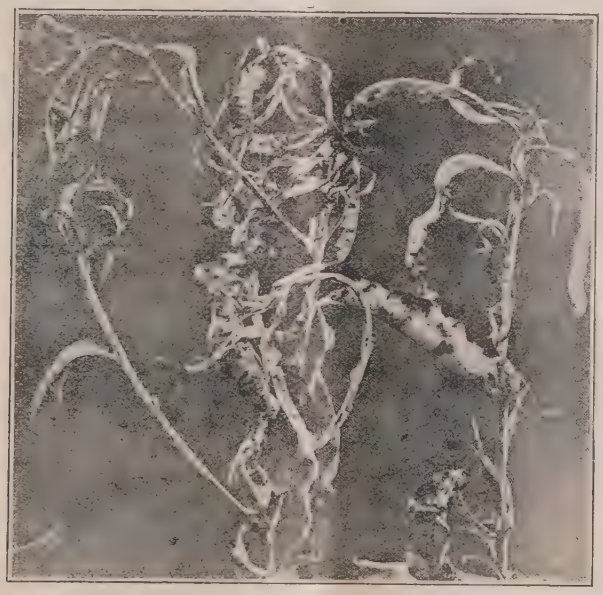
Life History—The fungus which causes the Scab winters over as dormant fungus threads (mycelium) in the twigs. In the spring these fungus threads produce spores in little pustules. These are scattered by wind, rain and insects, and infect the fruit and leaves.

Prevention—Varities subject to Scab or Black Spot should be sprayed with Dry Mix (wettable sulphur) or dusted with sulphur two weeks after the fruit is set and again in two weeks.

POWDERY MILDEW (*Sphaerotheca pannosa* (*Wallr.*) *Lev.*).

This Mildew attacks both the rose and the peach. It is most commonly seen on young peach trees which have not yet come into bearing, and frequently injures nursery stock severely. It does, however, sometimes occur on older trees. Certain varieties are particularly susceptible to it.

Symptoms—The Mildew is seen on the leaves, young shoots and sometimes on the fruit. The leaves become stunted, curled, pale,



Powdery Mildew on young peach twigs in nursery. Note the distorted, slender leaves, almost white with the fungus spore masses. (After Duggar.)

sickly, more or less folded lengthwise and covered with a dense powdery white substance, which extends over the twigs on which the leaves are borne. The Mildew is easily recognized by this dense white powdery covering on the affected leaves and shoots. It develops most vigorously in warm, moist weather, and is usually most abundant in late summer and autumn.

Prevention—At the first sign of the Mildew, dust with sulphur or spray with Dry Mix (wettable sulphur) and repeat at intervals of ten days as often as may be required to hold the disease in check.

CROWN GALL (*Pseudomonas tumefaciens* (Erw.) Smith & Townsend).

This is a bacterial disease which affects peaches, apples, plums, cherries, raspberries and many other plants. It is easily recognized by the woody, knot-like swellings seen on the trunk and roots. These galls vary in size. Some are not as large as a walnut, while some may be as large as or much larger than a man's fist. When these galls are on the trunk they are usually at or just below the ground. The extent of injury done to the tree by Crown Gall is an open question. Many affected trees continue to grow and appear to thrive normally. There is no doubt, however, that some trees are weakened and stunted, if not killed by the presence of the galls. Hairy Root of apples, often seen in nursery stock and easily recognized by the tufts of thread-like rootlets replacing the branches on the main root, is caused by the same organism.

Crown Gall on Apple. (Original.)

Prevention—In order to be on the safe side do not plant any trees showing indication of Crown Gall. Such trees should be returned to the nurseryman with the request for healthy trees to take their place. It is not advisable to plant fruit trees where raspberries have been grown, as raspberries are very subject to this disease. Care should be taken not to injure the crown and root of fruit trees as it is chiefly through wounds that the bacteria enter them. Trees that are so badly affected with Crown Gall as to be unprofitable should be removed. In the nursery seedling trees showing any signs of Crown Gall should never be used for budding or grafting purposes. Experiments conducted in the United States indicate that it is advisable to dip grafts in organic mercury solution (semesan) or Bordeaux mixture (i) after grafts have been well fitted and carefuly wrapped; (ii) just before planting.

*A Method for Control of Crown Gall in the Apple Nursery, U.S.D.A. Circular 376.

CANKERS OR GUMMOSIS OF PEACH TREES.

In certain localities in the Niagara district, especially at Queenston, Niagara-on-the-Lake, St. Catharines, and in several orchards at Winona and Grimbsy, it is a common thing to see large, black, gum-covered cankers, chiefly on the upper side of large branches. These cankers do not heal over but continue to widen out and enlarge until finally the whole branch dies. This usually takes several years.

The cankers have been attributed to various causes. Mr. W. A. McCubbin, of the Dominion Laboratory, who has made a special study of Peach Cankers, writes as follows concerning their origin:—

*"1. A very small percentage arise from holes made by borer larvæ.

*Bulletin 24, Dominion Department of Agriculture, "Fruit Tree Diseases of Southern Ontario."

"2. They may come as an after-effect from small-cracks in the trunks or limbs. The percentage thus found is also very small.

"3. A small number start from gum blisters under the bark.

"4. A few arise at the bases of twigs killed by Brown Rot. The Brown Rot fungus works back from the rotten fruit into the twig and then starts a canker in the larger limb.

"5. Wounds made by scraping the limbs, etc., are accountable for a small number.

"6. Quite a few cankers start at pruning wounds.

"7. By far the greatest proportion of cankers are formed on the limbs at the bases of dead twigs. There is presumably a fungus concerned here which, after establishing itself in the dead twig, runs back into the larger limb and there starts a canker."

Small cankers on peach branches. Natural size. (Original.)

Field observations made by the writers incline them to think that heavy pruning and heavy fertilizing, in combination with winter killing of bark and with wet weather early in the growing season, may also have some effect in inducing the formation of cankers.

Means of Control—Mr. W. A. McCubbin, after conducting many experiments on the healing of Peach Cankers, makes the following recommendation in regard to their prevention and control: Removal of the dead twigs from the main limbs, since it is found that these twigs are the starting point of the disease in such a large number of cases; destruction of Brown Rot mummies; painting of all the larger pruning wounds; removal of small limbs showing cankers, and the treatment of cankers on trunk or large limbs by cleaning out the cankers immediately after rain when

the bark and gum are soft, and disinfecting the wounds with formalin diluted one to ten, or corrosive sublimate, one in a thousand, and coating them with lead paint free from turpentine.

The field observations of the writers recorded above indicate that care should be taken not to over-prune or over-fertilize peach trees, as such treatment apparently tends to induce the formation of cankers.

Black Knot of Plums and Cherries, (*Ployrightia morbosa* (Schw.) Sacc.).

This is an extremely destructive disease, and in localities in Ontario where no special efforts have been made to control it, it has destroyed numerous cherry and plum trees. In well-cared-for orchards, it is kept under control and seldom causes serious injury. This is particularly true of orchards in the fruit-growing sections where spraying is generally practised and where the law requiring the cutting out of Black Knot is enforced.

Black Knot on plum twigs. (Original.)

Symptoms—The knots usually appear first in the spring of the year. The swellings are at the start slight, but gradually increase in size. The surface becomes cracked and covered with a light green coating consisting of numerous fungus threads (mycelium) and spores. The swellings are often spindle-shaped and usually confined more or less to one side of the twig. Later in the season, as the knots mature, they lose their green colour and become dry, hard, black and cracked, with the surface studded with minute black pimples which are the fruiting bodies (perithecia) of the fungus. The knots are most abundant on the twigs and smaller limbs, but are sometimes found on the larger limbs, especially in the crotches. Occasionally they occur on the trunks.

Life History—From late spring until midsummer numerous spores are produced on the young, developing knots, so that each is a source of infection to healthy limbs on the same tree or on other trees in the neighbourhood.

During the fall and winter another form of spore (ascospores) developes in the black pimples (perithecia) on the surface of the mature knots. These spores are mature and are discharged from late winter until early spring, according to the locality and severity of the season. Many of the knots are also perennial, producing fresh crops of spores each year.

Prevention—Cut out and burn the knots, taking care to cut well below the diseased area. This should be thoroughly done at least twice a year, in the fall or early winter and in late spring.

Spray plums and cherries as recommended for Brown Rot. Take special care to see that the first spraying is very thoroughly done. The branches, main limbs and trunks should be covered with the solution at this time. Black Knot attacks wild cherries and plums and there is a

possibility of it spreading from these to cultivated varieties. It is advisable therefore to destroy wild plums and cherries in the neighbourhood of the orchard if they are affected with Black Knot. The enforcement of the clause of the "Fruit Pests Act" regarding the cutting out of Black Knot should make it much easier for fruit growers to keep Knot out of their orchards.

PLUM POCKETS, (BLADDER PLUMS) (*Exoascus pruni* Fuckel).

This disease is common in Ontario on wild plums and on cultivated plums of the American varieties (*Prunus americana and P. nigra*). It is recorded also as sometimes occurring on the common or European plums (*Prunus domestica*). It is most prevalent in cold, wet springs. It cannot, however, be regarded as a disease of any great economic importance.

Plum Pockets or Bladder Plums. The fruit on the left is healthy, that on the right is diseased. (Original.)

Symptoms—Soon after the fruit is set it becomes swollen, hollow, without a pit or stone, and often distorted in shape. These light, hollow, bladder-like fruits have suggested the common name "Bladder Plums."

In the early stages, affected fruits are yellowish or reddish in colour. Later they become covered with a whitish bloom. This is due to the production of numerous spore sacs (asci) on the surface. These sacs (asci) contain ascospores. After these are discharged the fruit turns dark brown in colour and falls off.

Life History—The fungus which causes Plum Pockets appears to live over winter as spores, adhering on or between the bud scales. These germinate and produce infection of the young ovaries when the buds are bursting in the spring.

Prevention—Spraying as recommended for Peach Leaf-Curl appears to prevent this disease entirely.

LEAF SPOT, SHOT-HOLE FUNGUS, YELLOW LEAF DISEASE OF CHERRIES.

This is a very common and an exceedingly serious disease in Ontario. It is seen on wild and cultivated cherries and plums. It does most damage to cherries. Both sweet and sour cherries are frequently completely de-

foliated by it in wet seasons. In the years 1915, 1916 and 1928 it was particularly bad. It is usually regarded as doing most damage to sweet cherries but here in Ontario it has been just as destructive if not more so to sour cherries.

The disease on the different species of cultivated and wild cherries and plums is not all caused by the same fungus. Three closely related species of Fungi, each confined to certain species of cherries or plums, have been found to cause it. Coccomyces hiemalis, Higgins, causes the disease on sweet and sour cultivated cherries and on the wild pin cherry, C. pruniphorae, H. on cultivated plums of the European and American varieties and on two species of wild plum, C. lutescens, H. on wild black cherry, choke cherry and perfumed cherry.

Symptoms—These vary with different hosts. On the leaves of plums and wild cherries brown spots are produced, some of which soon fall out, leaving little holes, which give the leaf a "shot-hole" appearance. On cherries the spots on the leaves do not as a rule drop out so readily and are smaller. They are reddish-brown in colour and may be very numerous, so that nearly the whole surface of the leaf may be covered by them. Badly affected leaves turn yellow and drop. Cherry trees are frequently completely defoliated early in the summer. Such defoliation prevents the proper ripening of the wood and renders the tree very subject to winter killing. In the spring and summer of 1916, numerous instances were recorded of cherry trees not surviving the winter. When inquiries were made, it was found in nearly every case that the trees which were winter-killed had been defoliated by Leaf Spot the previous summer.

Life History—On the surface of the spots on the leaves numerous spores are produced. These can often be seen as little white, velvety pustules in the spots, usually on the under side of the leaf. These spores serve to spread the disease during periods of wet weather in the summer. Moisture is necessary for its spread. It is only in wet seasons that it causes serious injury. The fungus which causes the disease is carried over the winter in the fallen leaves. In these it produces fruiting bodies (apothecia). These contain another form of spores (ascospores). During wet weather in the spring, about the time the new leaves are developing, these spores are discharged from the fruiting bodies in great numbers. Some of them are carried by the wind to the young leaves, where they produce the first infection of the season, from which the characteristic spots develop a week or two later.

Prevention—Spray with Bordeaux mixture (3-6-40) when most of the shucks are off and add either 1½ pounds of arsenate of lead or 1 pound of arsenate of lime. In ten or twelve days spray again with Bordeaux and poison as above. Give a third spraying ten or twelve days later with lime sulphur, 1 gallon to 40 gallons of water (sp. gr. 1.007-1.008), 3 pounds of hydrated lime and either 1½ pounds of arsenate of lead or 1 pound of arsenate of lime (calcium arsenate). Put the lime in the spray tank before adding the poison.

POWDERY MILDEW OF CHERRY (*Podosphaera oxyacanthae* (*D.C.*) DeBary).

This Mildew is frequently noticed on cherries in Ontario. It does not usually injure old trees to any great extent. Young trees and nursery stock, however, are sometimes severely injured by it. Apples and plums are also affected by the same mildew, especially nursery stock.

Symptoms—The young shoots, tips of branches and leaves become covered with a white powdery mildew. On the leaves it is most abundant

on the lower surface. In severe attacks shoots and twigs are distorted and stunted and the leaves curled. Early in the season the mildew is white and more or less powdery, especially on young shoots and twigs. Later it becomes darker in colour. If the mildew on the lower surface of a leaf is examined at this time, numerous dark specks will be seen scattered among the white threads. These impart the darker colour to the mildewed areas.

Life History—On the surface of the leaves and shoots the white threads of the fungus (mycelium) can be seen with a hand lens. During the early summer from these white threads stalks are sent up which bear chains of spores (conidia). These spores are so numerous that they give to the mildew the characteristic powdery appearance. They serve to spread the disease during the summer months. Towards autumn minute

Leaf Spot or Shot-hole Fungus on cherry and plum. (Original.)

specks are seen among the fungus threads. These are at first yellow, later black in colour. They are fruiting bodies (perithecia), and each contains one large spore sac (ascus) with eight spores (ascospores) inside. These spores serve to carry the fungus over the winter. In the spring they are liberated.

Prevention—The sprays recommended for the control of Cherry Leaf Spot usually keep the Mildew under control. If Mildew appears dust immediately with sulphur and repeat the dusting at intervals of ten days until from three to five applications have been made, depending upon the severity of the disease. If a duster is not available spray at the times indicated above with commercial lime sulphur, 1 gallon to 40 gallons of water (sp. gr. 1.007-1.008). The addition of 3 pounds of iron sulphate to 40 gallons of the mixture tends to reduce the possible injury to the foliage and also increase its sticking quality.

INJURIES DUE TO WINTER OR TO LOW TEMPERATURES.

In this province, which is subject to cold winters and great extremes of temperature, winter injury or injuries caused by low temperatures, are common and very important. Hence every fruit grower should have a knowledge of the forms which such injuries take and of the simple means by which some of the worst of them may be prevented.

It is impossible to go into a full account of this subject, so that the following deals only with the more common or more important types of injuries. We have already referred to the winter killing of cherry trees as a result of early defoliation brought about by the Leaf Spot or Shot-hole Fungus disease. Hence this will not be dealt with here.

Effect of Sunscald on the southwest side of the trunk of a European plum tree. Most of the bark on the injured area has been killed and fallen off. (Original.)

SUNSCALD.

This is the most common form of winter injury. It occurs all over the province, but is worst in the colder portions. Thousands of apples, plums and cherries in almost every fruit-growing county are affected. The injury consists in the killing of the bark, often over an area three or four feet

or even more in length, on the south or south-west side of the trunks, and also in the case of apples on the upper side of large branches. The death of the bark is caused by its being heated up by the sun's rays on cold, bright days, especially in February and March, and then after sunset cooling off very quickly. The great drop in the temperature thus taking place in a few hours is very injurious to the tissues of the bark and, if frequently repeated, kills them. Sunscald also seems to take place on hot days in summer. To make matters worse, the dead sunscalded area on apple trees is commonly invaded by the Black Rot fungus, which gradually extends the injury and in many cases girdles the trunk or branch and kills all the parts above. Heart rots also may invade the injured area and greatly weaken the trunk. On plums and cherries it is chiefly the trunks that are affected and here, too, the injury may be increased by fungi or by borers working around the margins of the dead bark. Sunscalded trees, of course, often live for many years, and may bear almost as well as if the bark on the affected area had not been killed.

Methods of Control. (1) When setting out new orchards incline the trees a little to the south-west and head them low. This helps to shelter the trunks from the sun.

(2) In dehorning or pruning apple trees, never remove all the centre, thus exposing large branches to the direct rays of the sun. Such open centres are not only unsightly, but lessen the bearing capacity of the tree.

(3) The trunks and branches of Transcendent and Martha Crab apples are very resistant to Sunscald and the roots to root-killing, hence, if these were planted and the desired variety of apples grafted or budded on their branches, much of the danger of Sunscald, Root-killing and Collar Rot would be avoided.

(4) All dead sunscalded areas, especially on the trunks, should have the bark removed with a drawknife, and the wound painted with white lead or with coal tar. This will keep out the Black Rot and other fungi.

(5) The trunks may be protected against the sun's rays by various devices, such as wrapping them with white building paper, or using veneer, or even by tacking a board up against the south side. Whitewashing the trunk heavily about the end of January also helps. If building paper is used and is put on in late autumn and a little earth thrown up around the base, it will also keep off mice. Any form of protection against Sunscald should always be applied not later than about the middle of Jannary.

Crown Rot or Collar Rot.

This is the name commonly given to that form of injury which consists in the death of the bark around the base of the trunk of trees. The girdling may be either complete (and in such cases the whole tree soon dies) or may be partial, only one side or portions here and there being girdled. In the latter case, the branch or branches directly above the dead bark may die, but often the whole top may remain alive and healthy. There is a great tendency, however, for these semi-girdled trees to become completely girdled after a few years. Crown Rot is fairly common in apple orchards in most parts of the province, and is by no means limited to the colder districts. King of Tompkins is specially subject to it, but many other varieties also suffer.

There are several theories as to the cause of this Collar Rot, but the writer is convinced that the chief cause is low temperatures acting upon succulent tissues which have not been properly hardened up for winter.

The bark at the crown is much more tender than that higher up on the trunk, and hence where trees have been over fertilized or cultivated too late, this is the part that is most likely to be killed, especially if not protected by snow.

The death of the bark around the base of the trunk of peach trees and also of sweet and sour cherries, sometimes extending a short distance below the ground, is closely allied in nature to the Collar or Crown Rot of apples. It is usually found where the trees are in exposed situations or where wind currents sweep through the orchard, especially if the trees were very thrifty the previous summer and fall.

Methods of Control—(1) Do not plant on their own stock King of Tompkins or any other variety known to be very subject to this disease. If these varieties are desired, they should be grafted on immune or nearly immune stock, such as Tolman Sweet or Transcendent or Martha crab apples.

(2) Do not over-fertilize or cultivate so late that the trees will not have their wood and bark hardened up for winter. Cultivation, even in the warmer districts, should close by July 1st, and a week or two earlier in the colder districts. A cover crop should be sown as soon as cultivation is finished. This will help to hold the snow on the ground.

(3) There is much less danger of collar rot under sod mulch conditions than under cultivation.

(4) Never plough away from the trees in autumn, but see to it that the soil around the trunk is high enough so that no water will remain there.

(5) Where trees are only partially girdled, especially apple trees, it is a good plan to remove the dead bark and cover with coal tar the wood thus exposed. Rotten bark favours the entrance of fungi, hence the reason for its removal. The tar keeps out rain and so helps to prevent rot.

(6) If observed early in the spring after it has taken place the dead area may be bridge-grafted much the same way as for mice injuries.

Black-Heart.

After a very cold winter or after sudden extremes of temperature even in October or November, apple, pear and peach trees will sometimes on examination be found to have their wood killed and darkened, even though the bark and cambium are still alive. Young trees, including nursery stock, are more subject than old trees to this trouble, but the branches even of old trees may be affected. Where the injury occurs in the same tree a couple of years in succession, or where rot-producing fungi get entrance into the wood through some wound or opening, the tree or branch may become so brittle and weak that it will break off as a result of any slight strain. Such trees are, of course, worthless. Very often, however, trees, especially bearing trees, may be black-hearted, and yet live and bear good crops, though there is a great tendency for large branches to die from time to time. Some varieties of apples and pears are much more subject than others to Black-Heart; in fact the more tender the variety the more subject it seems to be to this disease. Peach trees, owing to the rapidity with which they make new wood, recover more fully from Black-Heart than apples or pears, but many peach trees also die as a result of the injury.

Methods of Control—(1) Do not plant any variety that experience shows is too tender for your district. Baldwins especially should not be

planted in the colder portions of the province or in counties subjected to great extremes of weather. Some of the hardiest good varieties of apples are, Melba, Duchess, Wealthy, McIntosh, Fameuse and Tolman. It is only very hardy varieties like these which should be planted in the colder parts of the province.

(2) Avoid late cultivation and over-fertilizing. (See under Collar or Crown Rot.) Yet on the other hand the trees must not be weakened by starvation and neglect. A golden mean is what is desired.

Root-Killing.

Almost every kind of fruit tree is liable to suffer to some extent from root-killing, but peaches, cherries, and dwarf pears grown on delicate quince roots suffer most. This form of injury is usually brought about by a combination of low temperatures and dry weather accompanied by evaporation of moisture from the soil. Hence it is most common in light soils and in situations where the snow blows off and the winds dry out the soil. Prolonged cold periods in a winter when there is little snow and little moisture in the ground are specially favourable to root-killing.

Control—Anything that helps to hold the snow on the ground and prevent evaporation will help; hence a good cover crop, such as rye, is recommended, or a covering of the ground with coarse barnyard manure.

Bark Splitting on Trunk.

This is moderately common. Fruit growers used to believe that it was due to trees being, as they called it, "hidebound," but it is now known to be caused by a great, sudden drop of the temperature which contracts the bark much more rapidly than the sapwood, with the result that it gives way at some one or more places, and once a rupture occurs the splitting readily extends up and down with the grain of the bark. Decid uous shade trees are also subject to bark splitting. Sometimes the splitting extends into the wood for some distance, but usually it is only the bark that is affected. In some cases the bark is not only split, but is also torn away from the wood for an inch or more on each side of the split.

Methods of Control—(1) Trees that have made a luxuriant growth and are not hardened for winter seem to be most subject to splitting; hence the remarks above on avoiding late cultivation apply here.

(2) If the bark has separated from the wood it will be well to remove it back to near where the union is intact and to paint the exposed wood with white lead. Cracks may be filled with grafting wax to keep out water. Always open the bottom of the injury to make good drainage and let out all water that otherwise would accumulate.

Crotch Injury.

In the colder portions of the province many trees are injured during winter at the crotch or fork, the bark at this part being killed. Bark at crotches is apparently more tender than on trunks or branches. If this dead bark is allowed to remain, and if there is not good drainage to carry off moisture, it will not be long until rot-producing fungi will gain entrance and cause the wood itself to decay, with the result that one or more large branches may break off or the whole tree be ruined.

Methods of Control—(1) Hardy varieties are not nearly so subject as tender varieties to this injury, hence in the colder districts too great care cannot be taken to set out only varieties that will be suited to the climate.

(2) When forming the head of young trees, distribute the main branches so that they will not come out together and thus form a weak crotch. It is a good plan to have a central leader or semi-central leader.

(3) Varieties that overbore the previous season are more susceptible to this injury; hence thinning of over-loaded trees would help.

(4) Where crotch injury appears, remove the dead bark and paint the wound with white lead or cover with grafting wax. Never use cement in a crotch, as it will crack.

Killing Back of new Growth.

It is a very common thing, especially after a severe winter, to find that numerous twigs, especially on peaches, have been killed by winter. The killing may extend two feet or more back from the tip. Trees that made a late growth in summer and autumn are usually the ones that suffer most.

Methods of Control—The general principles in regard to cultivation and fertilizing mentioned under Collar Rot apply here. If time permits the dead twigs should be cut out as soon as observed.

Killing of Fruit Buds.

Nearly every year many fruit buds on peaches are killed, though the leaf buds are uninjured. This is the chief reason that peaches require a mild climate. Cherry and plum buds, especially cherry buds, are also subject to winter killing, but will usually stand much greater extremes than peaches. The killing of apple and pear buds is not common. If a dead peach bud is cut through with a sharp knife, the centre will be seen to be brown or black; in cherry and plum buds the pistil shows brown.

Bud killing seems to be due chiefly to a sudden great drop or drops of temperature. If the buds have become somewhat too advanced through the occurrence of very mild weather, late in fall or in January and February, their destruction seems to take place more readily.

Methods of Control—The presence of a large body of open water by moderating the climate helps to prevent this injury. Apart from the choice of situation, all that one can do would seem to be to follow the well-known good methods of cultivation, fertilizing and pruning. Good air circulation is also valuable; hence in choosing a site for an orchard avoid air pits or places where the air circulation may be expected to be poor. Air drainage is almost as important in an orchard as soil drainage.

Killing of Blossoms and Young Fruits.

Late frosts during bloom or soon after may destroy numerous blossoms or even young fruits. The latter seem to be just as tender as the blossoms. Sometimes enormous losses are caused by these late frosts. Orchard heaters are used in some countries to prevent this injury. They have not, however, been much tested in Ontario. The question of sites is

important here, as frost is always more destructive where air drainage is poor. It is interesting to know that late-blooming varieties, as Spy, often escape injury, when earlier varieties, like Greening or King or Baldwin, are killed.

Russeting of Fruit and Crinkling and Rupturing of Leaves.

Late frosts, soon after or as the fruit is setting, may result in very conspicuous russet bands around apples and pears. These bands may be at the calyx end, or around the middle or nearer to the stem end. They are probably due to frost and moisture combined injuring the skin.

Some years the leaves are much crinkled and sometimes have the upper surfaces separated from the lower through spring frosts. There is apparently no practical method of preventing such injuries.

Lob-sided Fruits.

In the year 1927 many apples, especially Baldwins, in the western part of the Province, were lob-sided. This was due to a severe frost about the time the fruit was setting. The skin of the young apple was ruptured and in many cases at lease one or more of the carpels were killed. There seems to be no way to prevent such injuries, but fortunately they, like the russeting of the fruit, are rare.

ARSENATE OF LEAD.

This is the only safe poison on orchard foliage with water alone.

CALCIUM ARSENATE (arsenate of lime.) This costs on the whole only about one-third as much as arsenate of lead per barrel of spray. Its chief defect is that it cannot be used with water alone because of burning. With lime-sulphur it should always have 3 pounds of hydrated lime added to every 40 gallons of spray.

LUBRICATING OIL EMULSIONS.

FORMULA:

Lubricating oil	3 gals.
Bluestone	6 ozs.
Hydrated lime	6 ozs.
Water	3 gals.

Pour the oil into a container or into the spray tank; dissolve the bluestone in half the amount of water; stir the hydrated lime into the other half; pour these two together; then add them to the oil; and pump this mixture back upon itself through the nozzle under high pressure until all the oil is properly emulsified. Dilute with water to 100 gals., keeping agitator running while doing so. This gives a 3 per cent. emulsion.

Note.—The lubrication oil must have approximately the following characteristics:

Gravity at 60° F.....24 to 26 A.P.I.
Flash point (open cup).360° F. (minimum)
Viscosity at 100° F.....170 to 220 seconds (Saybolt).
Volatility (loss at 105°-110° C. after 4 hours) .... 0.41 per cent.
Pour and solid .....40°/35° F.

Such oil may be purchased from any large oil company.

CAUTION: Do not use oil sprays when temperature is below 40° F.

BORDEAUX MIXTURE.

Bluestone (Copper Sulphate).....	3 lbs.
Hydrated lime or fresh stone lime	6 lbs.
Water	40 gals.

Hydrated lime is much the more convenient form to use, as it can easily be secured and stored and does not require slaking.

Hydrated lime if left exposed to the air becomes worthless, so keep it in tightly fastened paper bags in a dry place.

TO PREPARE BORDEAUX MIXTURE.—Dissolve the bluestone; then nearly fill the tank with water; add the proper amount of dissolved bluestone; start the engine to agitate the liquid; add the hydrated lime or slaked stone lime, and agitate the mixture for about 5 minutes. If a hand outfit is used agitate by pumping the liquid back upon itself for 5 minutes.

Note.—The easiest way to dissolve bluestone in the crystal or lump form is to place 40 pounds of it in a bag and suspend this in a barrel containing 40 gallons of water in such a way that the bottom of the bags sinks only 3 or 4 inches below the surface of the water. Leave over night and in the morning all will be dissolved. One gallon of the liquid will now contain 1 pound bluestone. Small quantities can be rapidly dissolved in boiling water by stirring. Granulated bluestone dissolves very readily and is usually placed in the desired amount upon a burlap screen on the hopper or inlet of the tank and dissolved by the water being poured over it as the tank is filled.

LIME SULPHUR.

The commercial product is commonly used. For directions for making the *home-made lime-sulphur*, consult Bulletin 198, which also contains full directions for testing the mixture and for the use of the hydrometer.

DRY MIX (wettable sulphur) is a commercial product. Follow the manufacturer's directions.

SULPHUR-CASEINATE is a mixture of 8 lbs. sulphur dust and ½ lb. of calcium caseinate to 40 gals. of water.

DUSTS.

There are to-day two classes of dust: 1st, finely ground sulphur and arsenate of lead powder; and 2nd, finely powdered bluestone combined with lime and arsenate of lime. Either of these may be secured without the poison. In addition there are several forms of nicotine dust. Dusting is satisfactory as a supplement to spraying in large orchards, but we do not feel safe in recommending it as a substitute for the liquid spray. If so used apply at the same times as indicated for the liquid spray, but in wet weather give extra applications. Dust when air is calm, as, late in evening or early morning.

Note.—Bordeaux may be used with lubricating oil emulsion or other oil sprays.

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